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Zero-Magnetic-Field Phase-Decoherence Transition in Underdoped $La_{2-x}Sr_xCuO_4$[1] PAUL BAITY, XIAOYAN SHI, ZHENZHONG SHI, DRAGANA POPOVIĆ, Dept. of Phys. & Natl. High Magnetic Field Lab., Florida State Univ. — The two key prerequisites for superconductivity are electron pairing and phase coherence of the pair wave-function. We present an electrical transport study on underdoped $La_{2-x}Sr_xCuO_4$ (LSCO) films ($x = 0.07$ and 0.08) that suggests that, in zero magnetic field ($H = 0$), superconductivity is destroyed by thermal unbinding of vortex-antivortex phase fluctuations at a temperature T_{BKT}. In particular, current-voltage ($I - V$) curves follow a power law $V \propto I^{\alpha(T)}$ with $\alpha(T) \geq 3$ for $T \leq T_{BKT}$. In addition, the contribution of the superconducting fluctuations to the conductivity, $\Delta\sigma_{SCF}(T, H = 0)$, obtained by extrapolating the measured magnetoresistance from the normal state at high enough H and T, increases monotonically with decreasing T and diverges exponentially at T_{BKT}. These results suggest that the $H = 0$ superconducting transition, where the Ohmic resistivity also vanishes, is due to the loss of phase coherence and manifests itself as a Berezinskii-Kosterlitz-Thouless transition. Our findings agree well with other experiments on LSCO with higher doping.

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